Comparison, low emittance vs. lower emittance lattices

Low emittance lattice

Emittance = 3.5 nm-rad
Effective emittance = 3.9 nm-rad
coupling = 1%

	Sigmax um	Sigmaxp urad
Unmoved BM	106.9	63.7
ID	253.5	15.6
Moved BM	107.5	62.3

	Sigmay um	Sigmayp urad
Unmoved BM	27.1	1.7
ID	11.7	3.0
Moved BM	26.9	1.6

Lower emittance lattice

Emittance = 2.4 nm-rad
Effective emittance = 3.0 nm-rad
coupling = 3%

	Sigmax um	Sigmaxp urad
Unmoved BM	87.6	56.0
ID	270.5	11.1
Moved BM	90.6	55.6

	Sigmay um	Sigmayp urad
Unmoved BM	43.6	2.1
ID	14.4	5.0
Moved BM	43.3	1.9

Machine Startup, October 3 - October 9, 2002

- Precondition: 1 nC / shot to BTS dump

- Prepare for high emittance singlets 12-hour ll-on-ll operation

- Complete all required ACIS and MPS system validations

- Standardize to 7 nm lattice, including distorted sectors 18,19,20

- Establish stored beam, injection

- Recommission bpm system, including timing scans

- Restore orbit (generation of new SR ubop file)

- Perform scrapedowns to support BPM offset adjustment

- Reestablish sector 35 optical diagnostics performance

- Establish injection into 2.5 nm lattice (nux36nuy19) in preparation for week 2

Storage ring initiatives this run

- Implement routine > 20 Hz datapool IOC orbit correction

- IDXBPM Feedforward on TBD ID beamlines

- Implement lower emittance lattice as standard config.

- Define multibunch (> 100) operating mode to support April 03 SOM

- Cogging --> 24 uniform singlets vs. 22+1 fill pattern

- Verify stable 110 mA singlets mode for Feb. 03 SOM

- Implement lower emittance booster / BTS conguration

- Complete routine lattice correction software

- Complete CPU AC correction commissioning

Enhancements described at APS retreat May 15, 2002 by L. Emery

Lower emittance, top-up in operation

- The 2.4 nm-rad lattice is as low as possible given the accelerator hardware
- Non-linearity very strong, reduced dynamic aperture

Customized β functions

- Small β desireable to minimize impact of small-gap IDVC wake fields, and to reduce injection losses at ID.

Converging β can improve flux, but results in

- Poor lifetime
- Stronger non-linearity / reduced dynamic aperture
- Higher injection losses / insertion device damage
- Increased emittance

Long straight sections -

- Very flexible, higher flux, multiple undulators
- Easy for large gap undulator
- More difficult for small gaps: may need in-vacuum ID

Enhancements cont'd

Increased Beam Current

- 110 mA operation scheduled for one week in February, 2003
- Reduced lifetime (from synchrotron radiation gas load)
- More charge needed from injector

Increased Single Bunch Current

- Beam unstable above approx. 5 mA / bunch
- High charge bunches have shorter lifetime
- Feedback system may be required

Reduced beam energy

- emittance scales as energy squared
- wakefields worse, lifetime worse
- High energy x-ray experiments adversely affected

Enhanced beam stability

- IDXBPM feedforward on gap for distorted sectors -> sub microradian long term stability
- Cogging -> eliminate missing bunch
- More narrow-band bpms -> improved reliability of missteering interlock

Enhancements cont'd

Transparent top-up

- Eliminate 20 msec orbit transient
- Eliminate bunch pattern variation systematic effects

Lower emittance booster

- reduce injection losses / ID damage

Booster sub-harmonic rf cavity

- Support direct linac -> booster injection; obviate the PAR
- Improve bunch purity

Improve injection process

- Reduce insertion device radiation damage
- May require better collimation
- Need better transport line control, optics

Regulate beam size

- Eliminate gap-dependent beam size changes (nearly absent w/ lower emittance lattice)